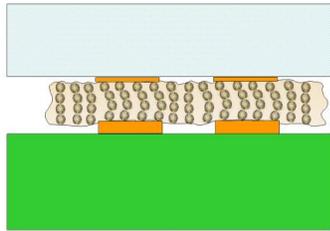




A PariProbe[®] Primer (for Technology Section of Web Site)

June 18, 2019

A PariProbe[®] contact starts with PariPoser[®] material - a thin elastomeric sheet with magnetically aligned nickel ball columns. When compressed, the nickel ball columns conduct current vertically, but not horizontally. There are 9 standard variations of the material with different size nickel balls that address device pitches from 0.1mm to 2.0mm. The nickel ball columns are uniformly formed throughout the sheets of material, so a contact can be made at any position on the sheet. The targets are typically flat pads of gold plated copper traces on a PCB.

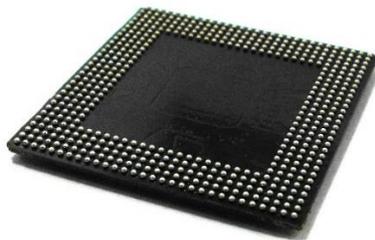


Cross section of PariPoser[®] material



PariPoser[®] material mounted on a frame

When targets are not flat, or when the material of the target is potentially damaging to the elastomer, a secondary metal interposer (a PariProbe[®]) needs to be placed between the PariPoser[®] sheet and the target.



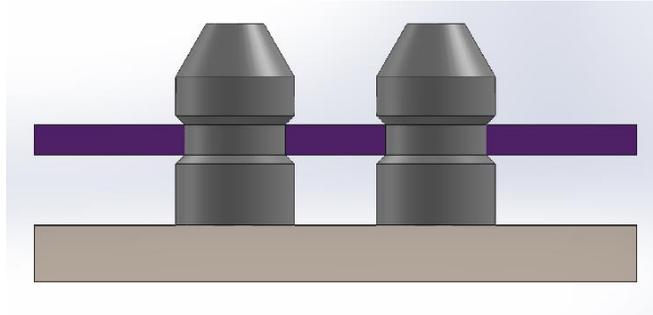
Solder ball targets of a BGA



Irregular shaped targets in a connector



4-point crown for a solder ball



Conical shape for recessed target

The PariProbe[®] contacts (of any shape required for the DUT target geometry) are held in place by a thin sheet of insulating material. The positions of the metal contacts are determined by the hole positions of the thin insulating material, and they match the location of the targets on the DUT. PariPoser[®] ball columns are positioned throughout the entire sheet, so the PariProbe[®] contacts can be used for any DUT pattern. The contact pitch can range from 0.4mm to above 2.0mm.

Typically, the PariProbe[®] subassembly (called the contactor) is then placed into a connector or socket frame.



Assembled socket with an inner contactor, an outer frame and a closing mechanism



Some reasons to use a PariProbe® :

Shape of target

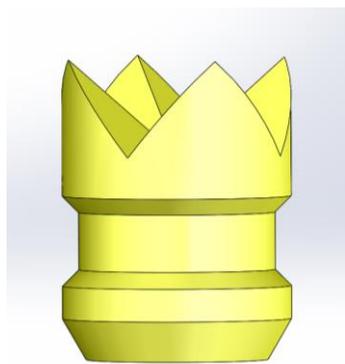
Elastomer contact performance is very sensitive to the shape of the target. If the target shapes are not compatible to an elastomer (for example: a sharp object, or a deep cavity), some kind of interposer is needed.

High tin solders

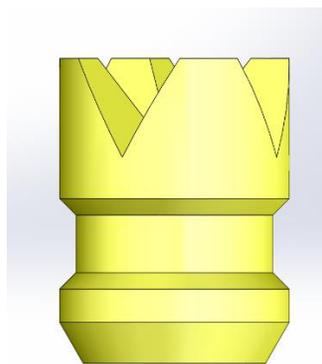
All metal-filled elastomers are susceptible to damage from the tin in a solder ball. Tin is particularly aggressive when it comes in contact with other metals (that's what it's supposed to do). Tin might stick to the elastomer's metal particles and form an insulating oxide. Or, it might adhere to the metal fill and pull the particles out of the elastomer when disengaging.

A PariProbe® is usually a precision machined BeCu part that is plated with Palladium Cobalt. Typically, it is < 1 mm long, with a diameter of 0.3 – 0.8mm. The very short overall length of the contact significantly contributes to a good bandwidth rating. The PdCo plating is a very hard and noble surface that has good durability and is not susceptible to tin migration.

Some typical shapes:



For piercing oxides



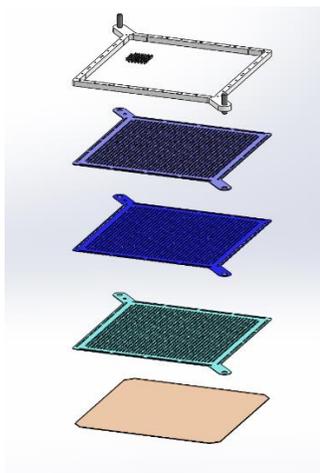
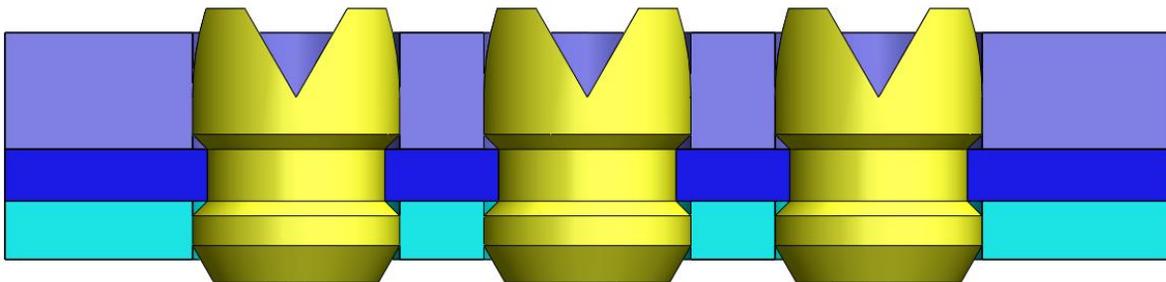
For cradling a solder ball



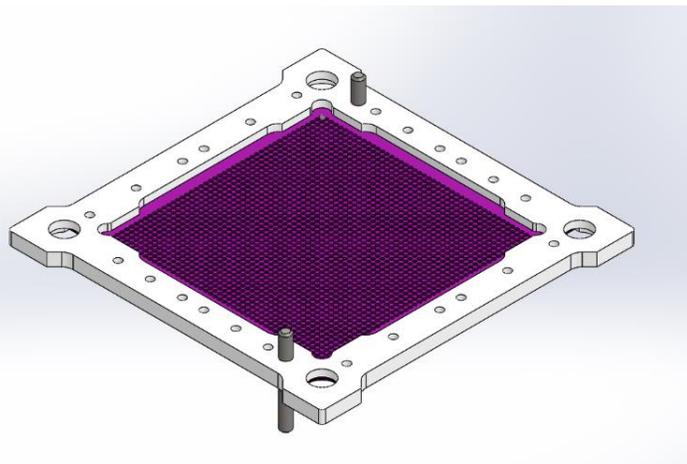
For a power contact



There are multiple layers of Kapton used in the PariProbe[®]/PariPoser[®] subassembly. The middle layer (the carrier) snaps into the reduced diameter section of the probe. The lower layer places the probes at the proper height above the PariPoser[®] material (pink color below). The top layer keeps the probe in the correct alignment to hit the target.



Exploded view with Kapton layers, a frame, and PariPoser[®] material



Assembled inner frame (contactor)

After assembly into the Kapton layers, the probes can move a bit in the Z axis. This gives the contactor some additional compliance.



PariProbe® Features

1mm overall length
 Multiple tip shapes
 Multiple pitch options
 PdCo plating
 Modular inner frame (contactor)
 Lower cost than most spring pins

Benefit

Low profile and favorable bandwidth
 Used in many different applications
 Device pitch range from 0.4mm to 1.0mm
 Minimizes tin migration from solder balls
 Easily replaceable for repairs and cleaning

PariProbe® limitations

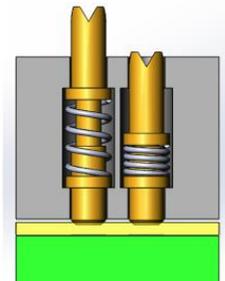
Limited compression
 The DUT cannot be warped
 Neighboring contacts need to be co-planar

Counter measure

Consider the Hybrid PariProbe® version
 Consider the Hybrid PariProbe® version
 Consider the Hybrid PariProbe® version

Summary of typical specifications for a **0.8mm** pitch BGA contactor

	Short Spring Pin or Hybrid PariProbe®	Traditional PariProbe®
Length	2.7mm	1mm
Diameter	0.57-0.6mm	0.6mm
Travel	0.4mm	0.1mm
Normal Force	20 grams	30-40 grams
DC resistance	< 50 mΩ	< 30 mΩ
Self inductance	0.5 nH	0.3 nH
Current Rating	1.9A	> 5 A
Bandwidth @ -1dB	10-20 GHz	40 GHz
Temp. Rating	125 °C	150 °C
Durability	500K+	500K+

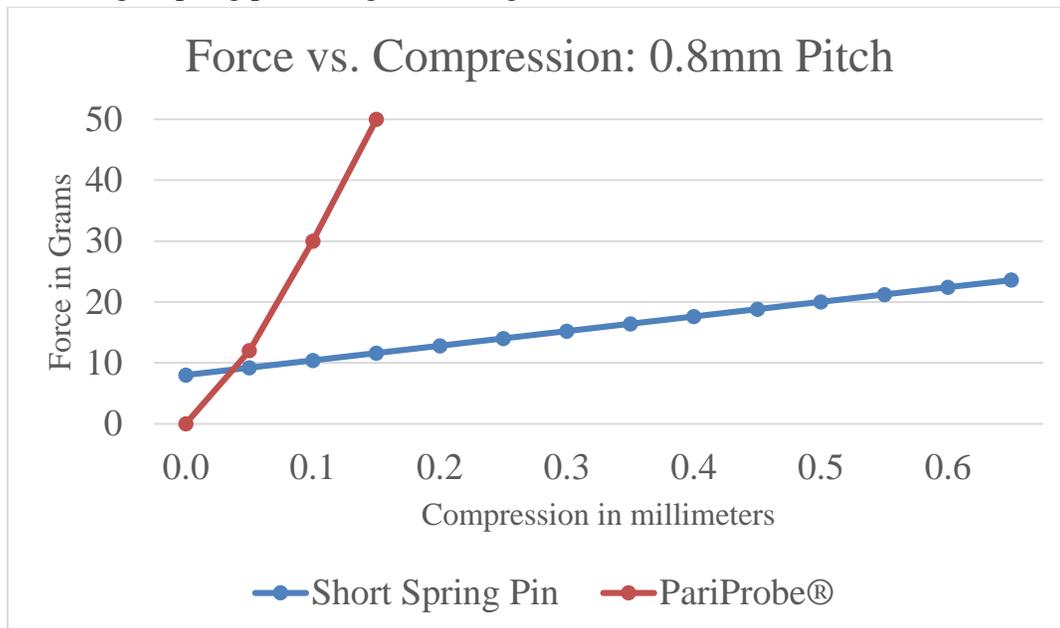


Plunger travel: 0.4mm
Overall length (compressed): 2.7mm

Hybrid PariProbe® with additional compression from the top plunger

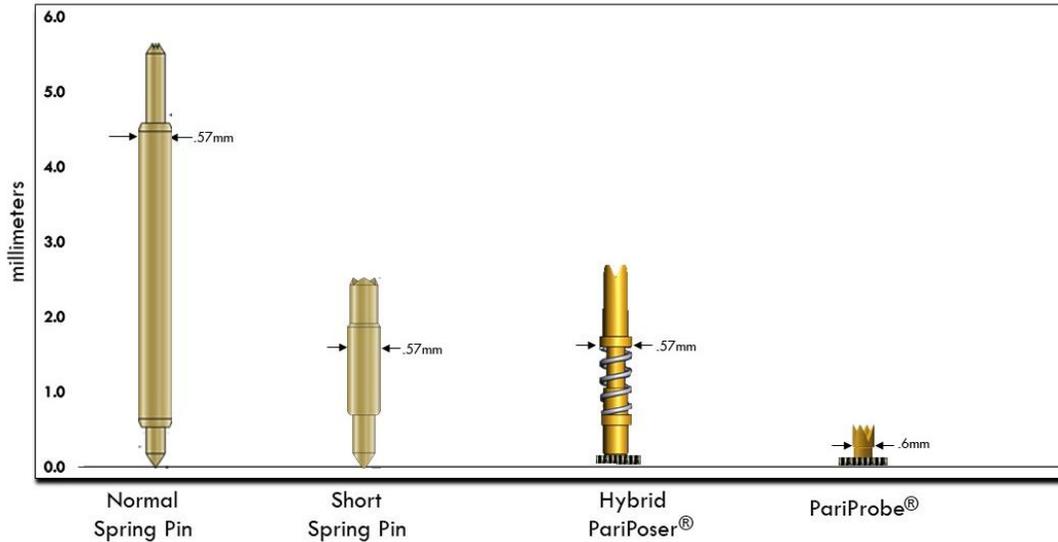
For additional information about the Hybrid PariProbe® please look at the other sections of the Paricon Web Site.

The biggest challenge in using a PariProbe® contactor is to manage the limited amount of compression and the amount of normal force at each contact location. Compared to spring pins that use a compression spring, elastomers have a small amount of compression, but they reach a high normal force per contact and a low contact resistance almost immediately upon being compressed. Short spring pins (2-3mm overall length) have limits on the normal force due to the limited space available for the compression spring, but they are very tolerant of plunger travel variations. (Longer spring pins can generate higher normal forces.)

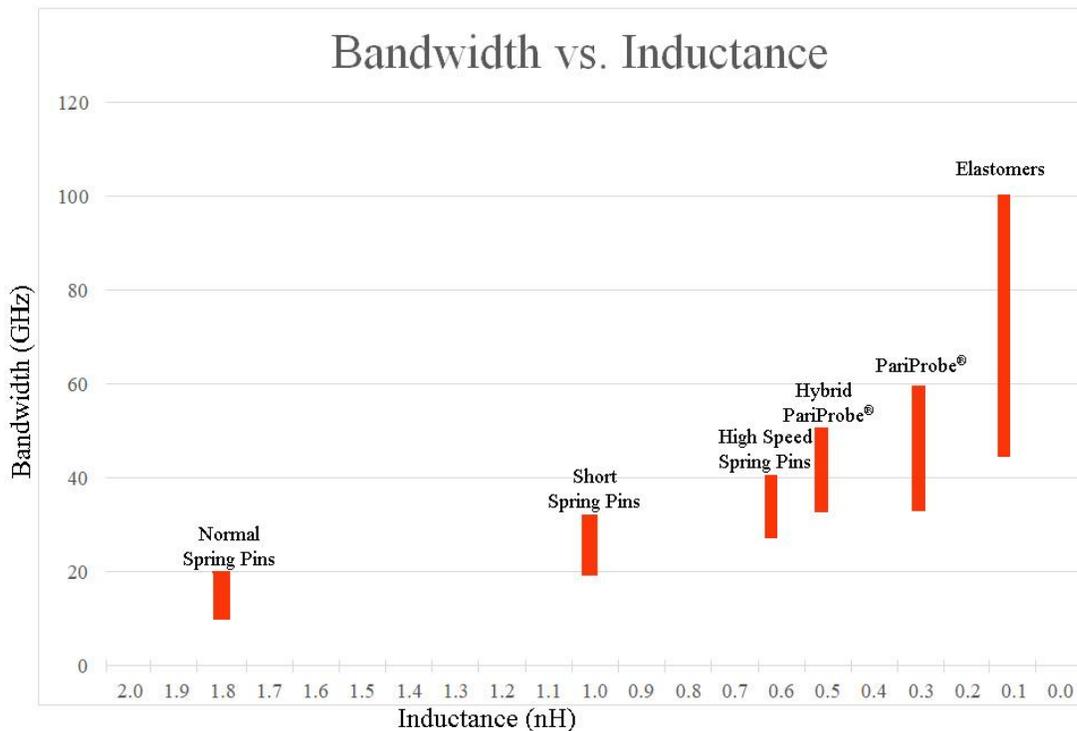




0.8mm Pitch Contact Lengths

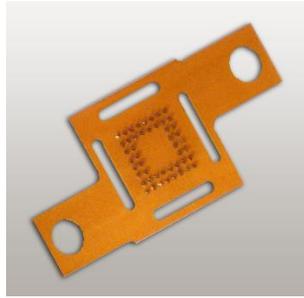


To successfully use an elastomer/PariProbe[®], the DUT and the PCB needs to be flat and there needs to be a uniform load over the entire DUT. If those items are well done, high performance results will be achieved. If those items cannot be controlled, then a spring pin or a Hybrid PariPoser[®] will be required – even if the bandwidth results are diminished.

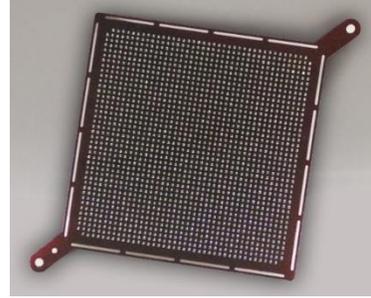




PariProbe[®] contactors (inner frame subassemblies) are less costly than traditional spring pin contacts inner frames. This is especially true for high pin count applications. (The lower cost is due to the simplicity of the PariProbe[®] component parts, and the reduced assembly labor costs.)

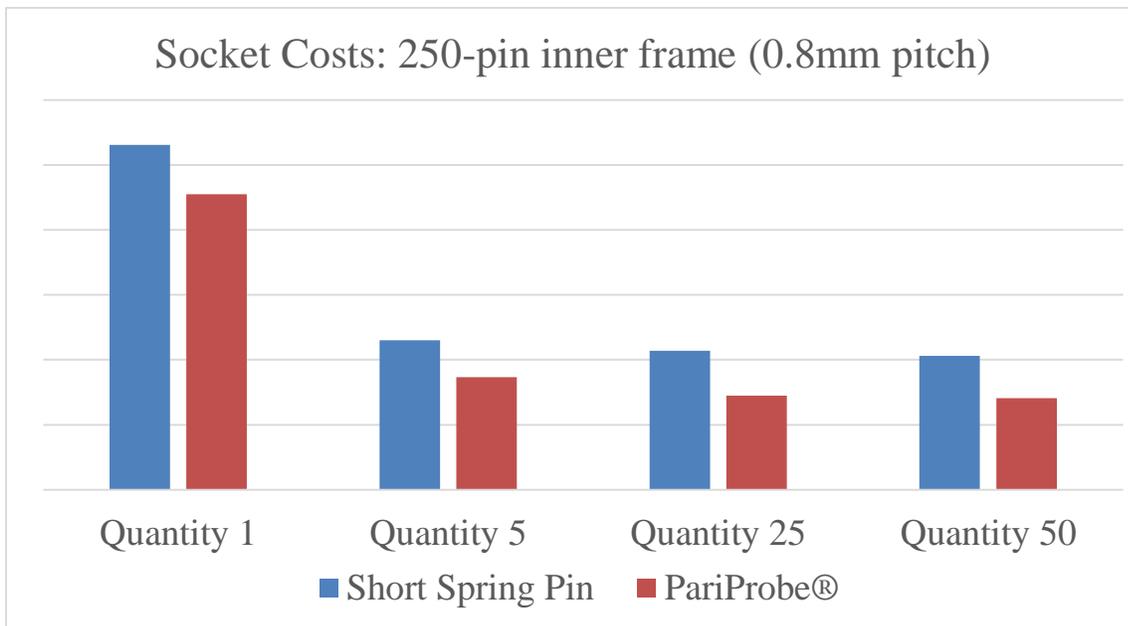


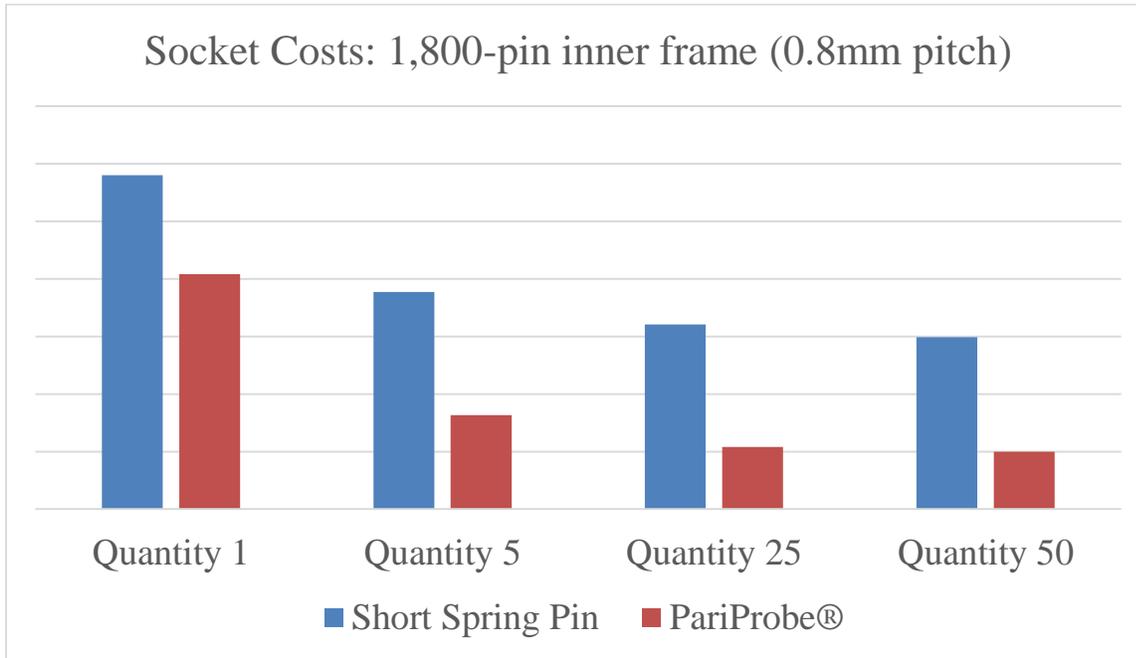
Contactor with a small number of probes



Contactor with a large number of probes

It's difficult to predict the requirements and costs of the outer frame (it might include cooling fins or other mechanical features), so the charts below only highlight the costs of the inner frames (the contactor).





There are other contact technologies that will be compared at a future time.

Paricon holds a significant portfolio of patents concerning elastomeric contacts. Some of those patents include the concept of a metal top-cover or interposer scheme on top of the elastomer. (The PariProbe® concept) These patents are available for use by 3rd parties under licensing agreements.